

Weather, Impacts and Trends in 2024:

Report for the City of London

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Executive Summary

This annual report is undertaken to assist the City of London as they implement their Climate Emergency Action Plan. It describes notable severe and extreme weather-related events that occurred in 2024 in the local, provincial, national and global contexts. The report also attempts to put these events into historical context and discusses available trend information.

The year 2024 was the warmest year on record globally going back to 1850. January to June of 2024 extended the period of record global warmth that began in 2023 to 15 months, due in part to an El Niño that peaked early in 2024. Canada continues to warm more than the global average with the national air temperature anomaly 3°C above the 1961-1990 average and with particular warmth in the Arctic in 2024.

Monthly precipitation in southwestern Ontario ranged from well above to well below normal. With the exception of an EF2 tornado recorded near Cambridge, all tornadoes that occurred in the region were weak. All recorded downbursts in the region were rated at EF0 (lowest on the EF scale).

London saw an anomalously warm winter, common with much of Ontario but a mostly near-normal summer, with two heat waves in June. The fall again showed several very warm periods. Six days met or set records of daily maximum temperature during 2024.

London experienced several significant precipitation events in 2024. A massive snow squall event in early December brought more than 50 cm of snow to the city. Waves of intense thunderstorms dumped over 100 mm of rain in the city over July 15 and 16, resulting in road and basement flooding. And a hail storm just several days later caused damage in the northwestern part of the city.

Lastly, while two weak tornadoes did occur within the city limits, the highest wind gust recorded at London's airport in 2024 was well below the severe threshold of 90 km/h.

Global and National Scale Overview

The year 2024 was the warmest year in the 175-year global observational record (Fig. 1). The last 10 years have also been the warmest 10 years on record (WMO 2025). January to June set new record global warmth, extending the period of record warmth that began in 2023 to 15 months (Carbon Brief 2025). Large parts of the world had 2024 temperatures ranked in the top five warmest years (Fig. 2) and temperature anomalies were particularly large in North America, especially in central and northern Canada.

The forcings of large scale climate change, atmospheric concentrations of carbon dioxide, methane and nitrous oxides continue to increase. Along with warmer air temperatures, 2024 also set new highs in global temperatures over the land surfaces (2.3°C over pre-industrial levels), ocean temperatures (WMO 2025) and the amount of atmospheric water vapour (Fig. 3); Copernicus CCS 2025), which is an important driver of extreme weather events. The WMO notes the rate of ocean warming in the past 20 years is more than twice the warming observed from 1960-2005.

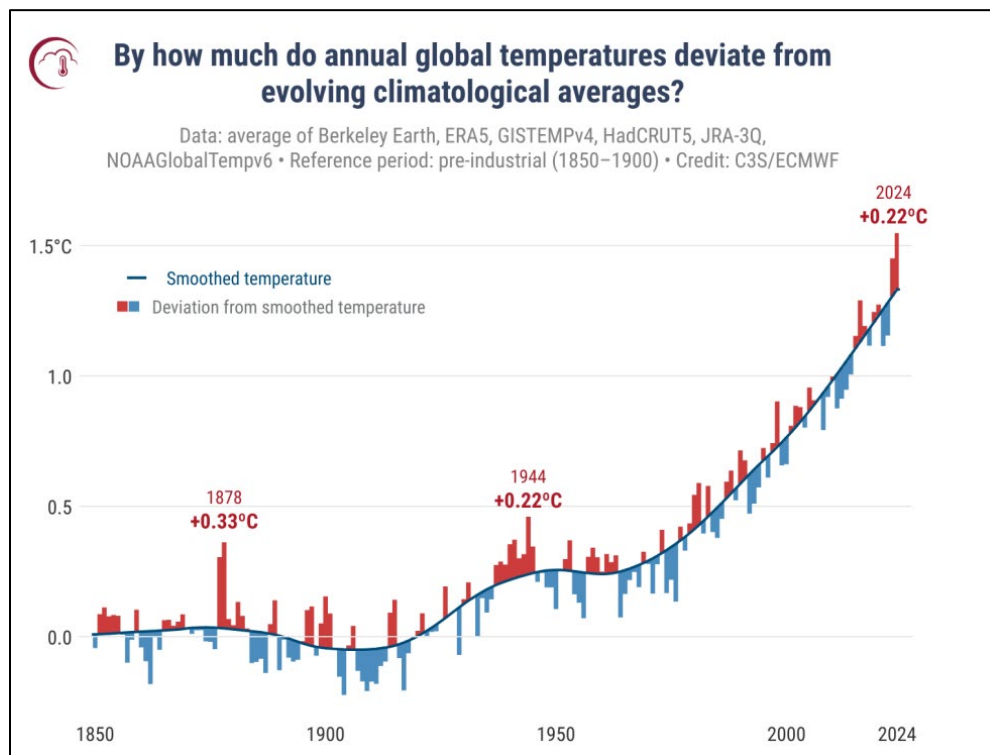


Figure 1. Difference in global average temperature from the 1850-1900 level based on averages of monthly values from up to six global datasets. The black curve represents the estimate of long term climatological variation of temperature. The red and blue bars show the deviations of annual average temperatures from this estimate. Figure source: C3S/ECMWF as shown in Copernicus CCS (2025).

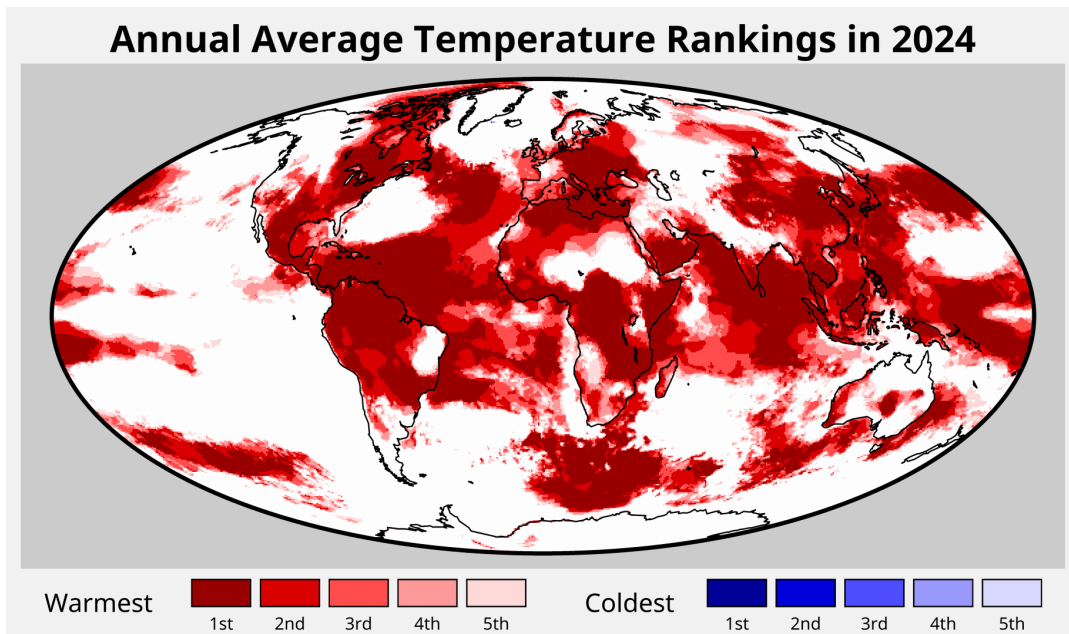
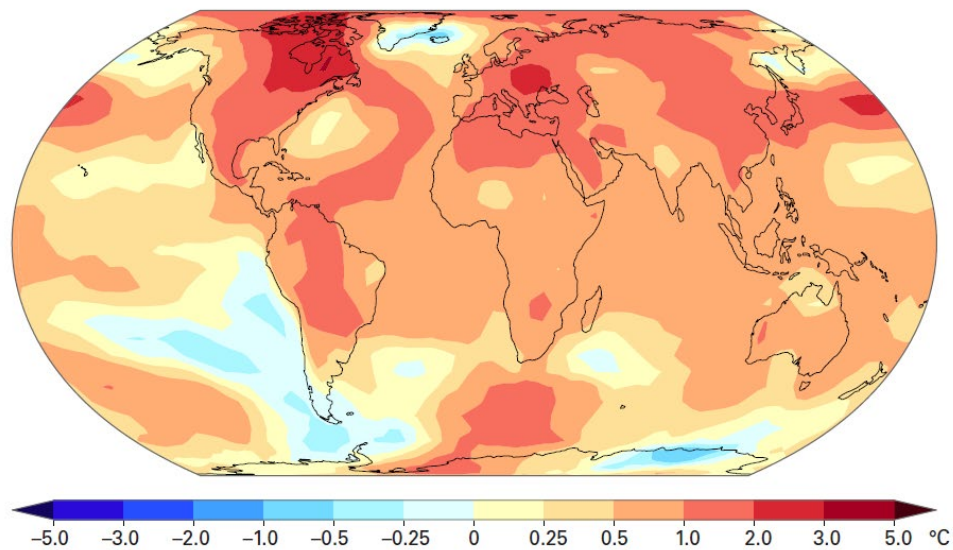


Figure 2. Top: The annual average air temperature anomalies relative to the 1991-2020 average. The analysis is the median of six global temperature datasets as shown in WMO (2025). Bottom: regions of the world that ranked in the five warmest (red shading) and coolest (blue shading) years for 2024. Figure from Berkley Earth as shown in Carbon Brief (2025).



Anomalies and extremes in total column water vapour in 2024

Data: ERA5 (1992–2024) • Reference period: 1992–2020 • Credit: C3S/ECMWF

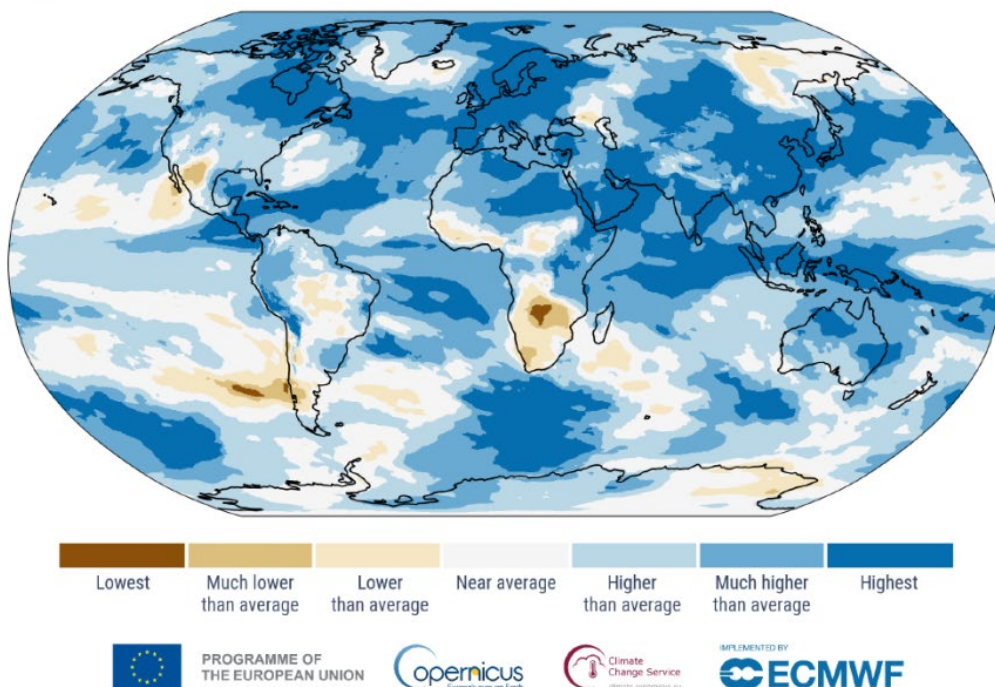


Figure 3. Total column water vapour – the total amount of water vapour in the atmosphere measured from the ground to the top of the atmosphere. The colour coding of the anomalies are relative to the 1991–2020 reference period with the extreme ('lowest' and 'highest') categories based on rankings for 1992–2024. Source: C3S/ECMWF using data from ERA5 as shown in Copernicus CCS (2025).

The global warmth in 2024 was due in part to a strong El Niño that peaked early in 2024 but other factors may also be contributing: early analysis from WMO indicates that reductions of aerosols in East Asia and from global ship traffic due to cleaner fuel sources (aerosols from dirty fuel sources reflect sunlight and create a cooling effect) combined with the solar cycle onset have created an additional positive radiative forcing (WMO 2025). Unusually low Saharan dust concentrations in the summer of 2023 (leading to warmer ocean temperatures) and some potential warming from a large volcanic eruption that injected significant water vapour in the stratosphere may also have contributed (Hausfather 2025a). Expectations are for 2025 to be slightly cooler than 2024 but still likely a top-three warmest year globally (Hausfather 2025b).

Environment and Climate Change Canada reported a national average temperature anomaly of +3.0°C above the baseline 1961–1990 reference period (Fig. 4). In Canada this ties 2024 as the warmest year with 2010 over the period of record that began in 1948 on a national scale. The warm anomalies were particularly large in the Arctic (Fig. 5) but also covering large parts of Ontario and Quebec. This larger warming relative to the globe is due to polar amplification,

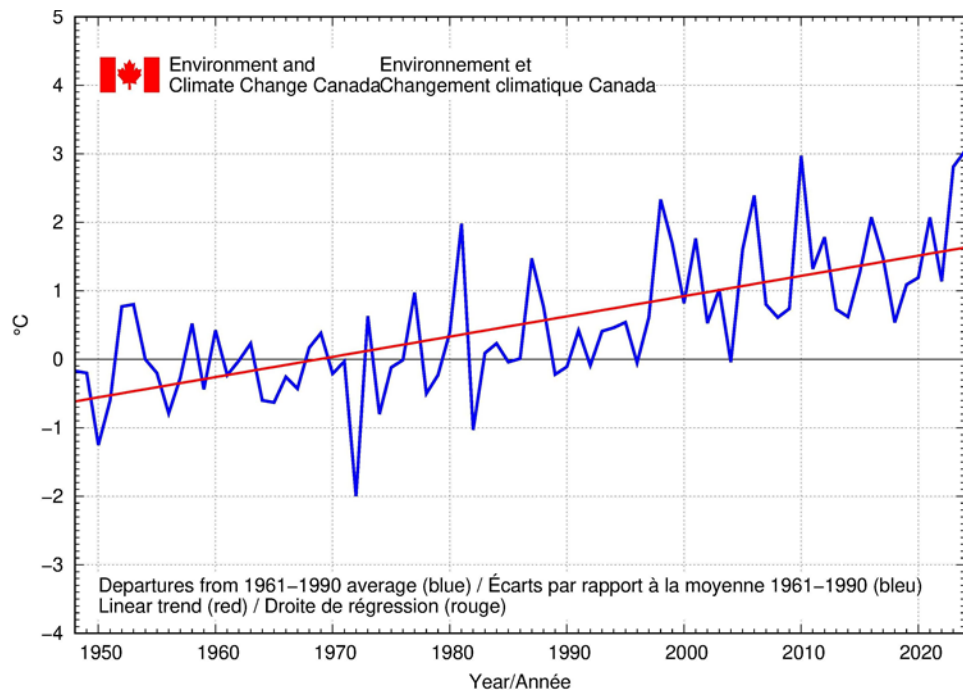


Figure 4. National temperature anomalies, represented as the difference for each year from the 1961-1990 average, for Canada over the period 1948-2024.

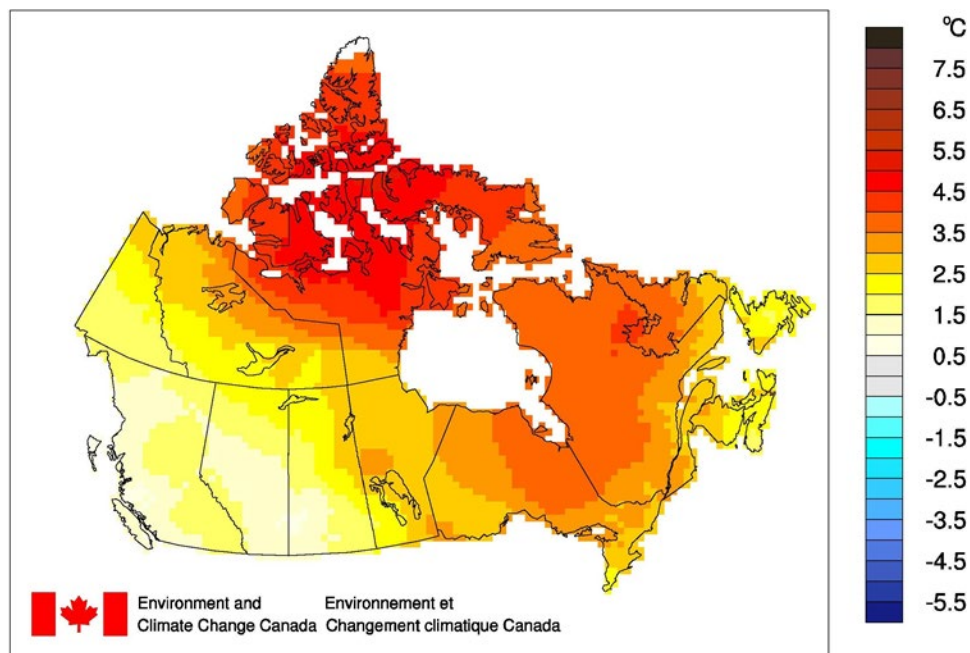


Figure 5. Map of temperature anomalies, the difference from the 1961-1990 average, for 2024.

which sees high latitude regions of the continents warming much faster due to a positive feedback between sea ice and snow cover loss and temperature. The WMO extreme events dashboard reported four events for Canada: an early August heat wave in the Northwest Territories and floods in southern Quebec at the same time due to the remnants of hurricane Debby, the July Jasper Wildfire and a mid-January cold wave in western Canada.

London and Region Overview

The winter was mostly above normal temperatures, especially February and early March with one brief cold spell in mid-January (Fig. 6). The summer was closer to normal with a series of warm periods returning in the fall.

Precipitation in southwestern Ontario ranged from well above to well below normal – sometimes from one month to the next (e.g. January vs February, respectively). The London

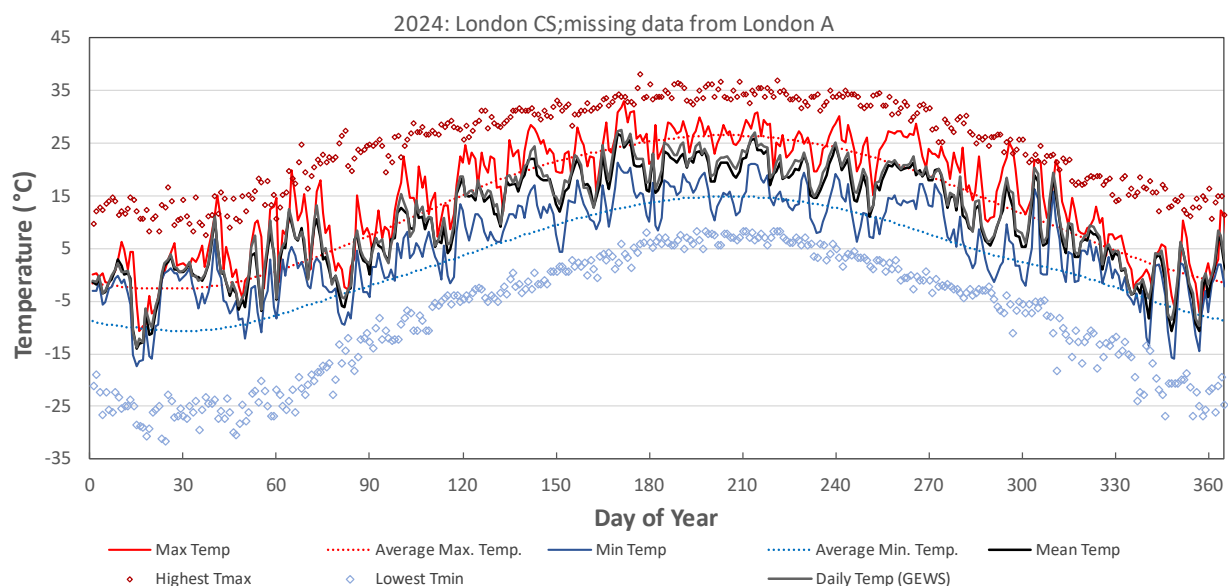


Figure 6. London air temperatures to date for 2024 from the London Climate Station at London International Airport (YXU). Daily maximum (red), minimum (blue), and average (black) air temperatures from the London CS station located at the airport, along with the average maximum and minimum temperatures for that day (red and blue dotted lines respectively) and record maximum and minimum daily temperatures for the past 84 years using a combination of stations located at or near YXU. Also included is the temperature from the Geography and Environment Weather Station (GEWS) located near the Social Science Centre at Western University, representing an urban-influenced measurement (approximately 1°C warmer on an annually averaged basis).

area experienced heavy snowfall on February 15. During the March-June period, precipitation was near or slightly above normal, with heavy snow squalls causing disruption in the London area on March 20. August was also slightly above normal. July had the highest departure from normal with 200+% of normal precipitation in the London area and northeast to the Greater Toronto Area (Fig. 7). September, October and November had below normal precipitation. Several rounds of snow squalls during the beginning of December brought impressive snow accumulations and related disruption. The monthly total precipitation for London was 197% of normal for December.

While extreme precipitation events are expected to increase in the future, the observational record for London has not yet shown robust evidence of an upward trend in short-duration rainfall extremes. There are suggestions of weak upward and downward but none of them have statistical significance. This is in contrast to Canada as a whole, which has been found to be experiencing an increase in precipitation intensity for the shortest sub-hourly to hourly timescales (5-min to 2-h durations), as found by Canon et al. (2024). Even so, trends at various locations across Canada are variable in magnitude and well as sign (positive or negative).

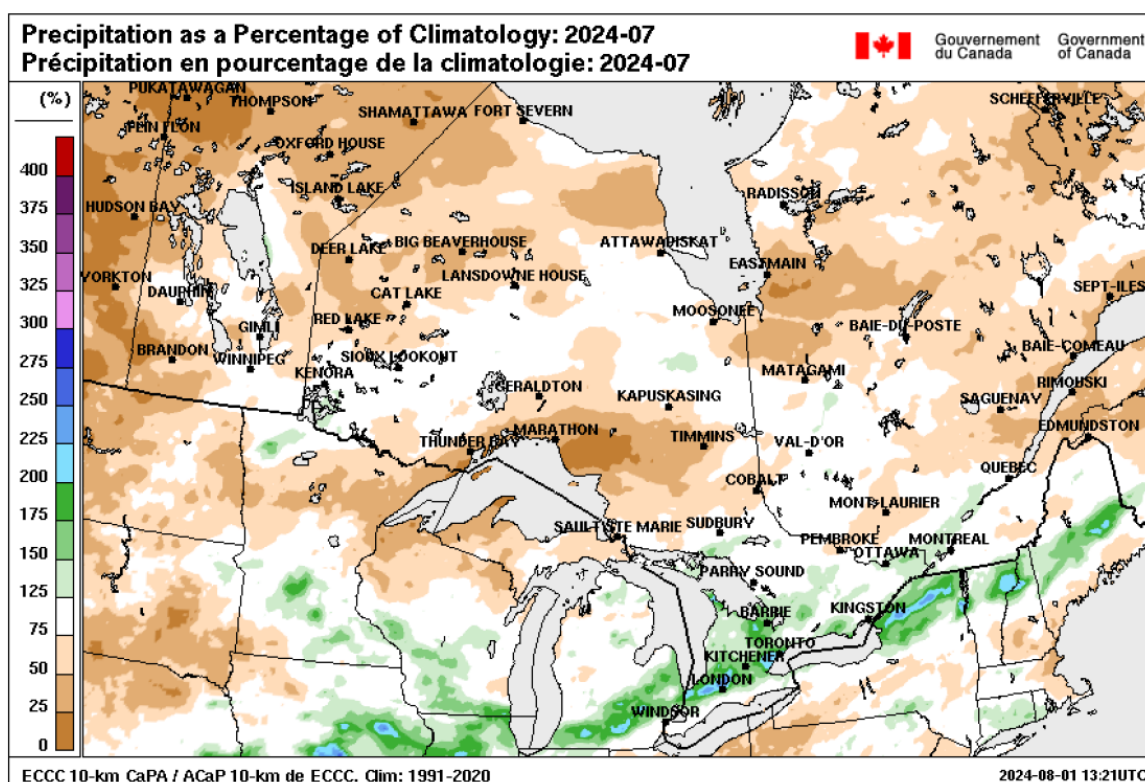


Figure 7. Chart showing that parts of southern Ontario experienced well above normal precipitation during the month of July while other regions of Canada experienced below to well below normal precipitation.

No severe wind events (90 km/h or more) were recorded at YXU with the highest gust being 73 km/h on April 12 during the passage of a significant spring storm system. On July 10, two low-end EF0 tornadoes developed in the northwest part of London as the remnants of Hurricane Beryl passed through. More generally, there were roughly a dozen tornadoes in southwestern Ontario with all but one being weak (rated EF0 or EF1, Fig. 8). An EF2 tornado that hit the Town of Ayr on August 17 was the only strong tornado to occur in any of Canada's densely populated regions. A slightly greater number of thunderstorm-related downbursts occurred across southwestern Ontario but all damage was minor and rated at EF0 (Fig. 9).

Significant Events in London and Region

Temperature

There were no record setting cold days and there were more than twice as many days with their high temperature greater than the normal versus low temperatures less than normal (Table 1).

The winter period (Dec-Jan-Feb) was anomalously warm Ontario-wide with only brief, short-lived cold spells. February saw two anomalously warm periods when temperature records were broken in southern Ontario. In London, on Feb. 9, 2024 the maximum temperature of 15°C set a record. In comparison, the normal maximum temperature for that day is -2.3°C and that for the month of February is -0.6°C.

March had higher temperatures than normal in southern Ontario with record warmth in southwestern Ontario during the first and second weeks. London equaled a record on March 4 (19.8°C, normal average max for the day is 1.5°C) and was also very warm (18°C) on March 13 (but not a record). April had two warm periods with a record-matching 22.4°C in London on April 9 and a 6 day warm period at the end of April with daytime highs greater than 20°C. May was warmer than normal for most of the province.

The summer (Jun-Jul-Aug) was characterized by mostly near-normal temperatures but with an intense heat wave in the first and third weeks of June. London experienced 5 days (in a 6-day period) where the maximum temperature exceeded 30°C in the third week of June.

Above normal temperatures returned in the fall, with October having two instances where London matched its record highs for the day and a three day period near the end of the month with daytime highs over 20°C (normal monthly maximum temperature is 14.7°C). Early November had two days with day time highs exceeding 20°C with that on Nov 6 matching the long-term record of 21.4°C. December was closer to normal temperatures but with the last week of the year warmer than usual with some locations in southern Ontario setting new records.

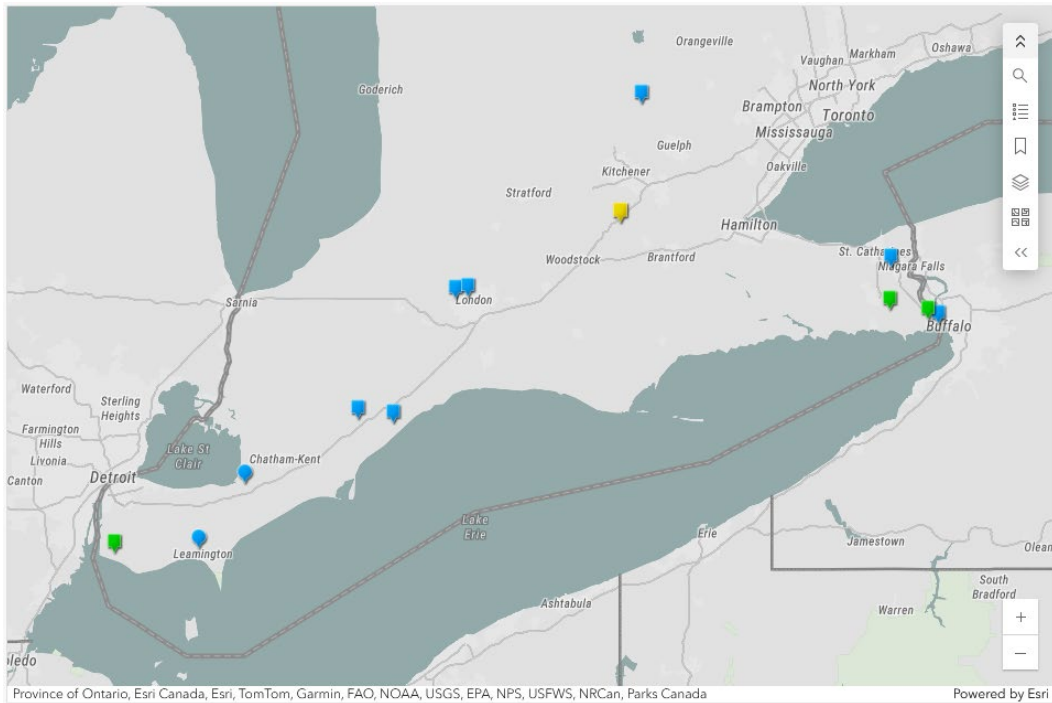


Figure 8. Tornadoes in the region in 2024 via the Northern Tornadoes Project.
EF-scale ratings are EF0 (blue), EF1 (green) and EF2 (yellow).

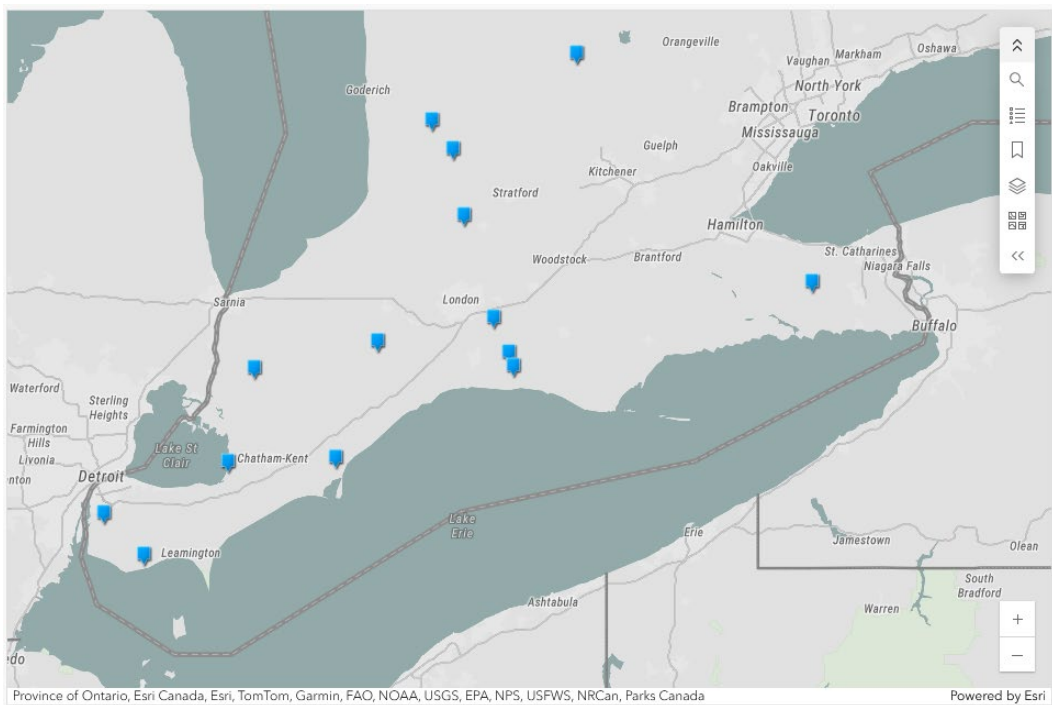


Figure 9. Downbursts in the region in 2024 via the Northern Tornadoes Project.
All downbursts were rated EF0 (blue).

Table 1. Counts of days with temperature anomalies in London for 2024.

Parameter	Count for 2024
Number of days when the daily maximum temperature is greater than or equal to the record for that date	6
Number of 'heatwave' days (daily max temperature > 30°C)	6
Number of days when the daily mean air temperature > the average maximum daily temperature	102
Number of days when the minimum temperature > the average temperature	104
Number of days when the minimum temperature > the average maximum temperature	34
Ratio of days when the maximum temperature is > the average maximum for the day vs the minimum temperature < average minimum for the day	2.21
Number of days with a record low daily minimum temperature for that date	0

Heating and Cooling Degree Days

Degree Days are calculated from the difference in temperature of the daily mean temperature above or below a given threshold temperature, where each difference in degree is a 'degree day'. A threshold of 18 °C is used to characterize the demand for heating (degree days below the threshold) and cooling energy (degree days above the threshold) in buildings. These are referred to as heating degree days (HDD) and cooling degree days (CDD) respectively.

Fig. 10 shows the changes in HDD and CDD over the last 5 climate normals (30 year) periods

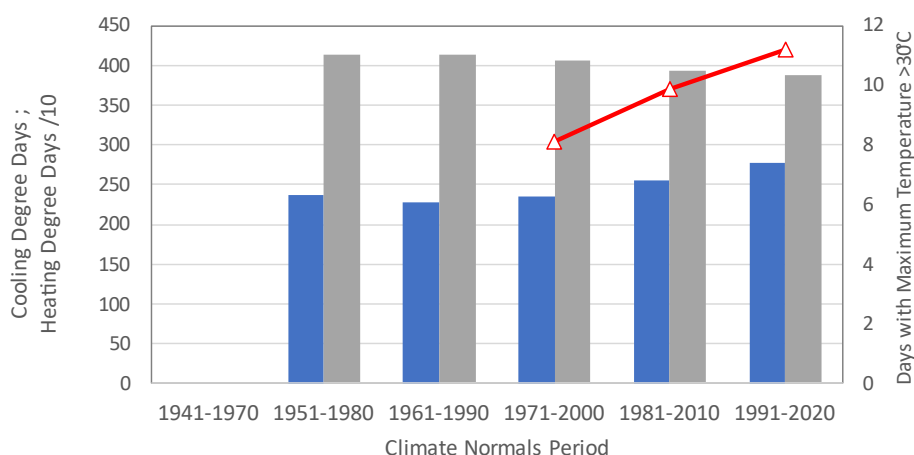


Figure 10. Heating (grey) and cooling (blue) Degree Days along with the number of days (red triangles) with maximum daytime temperature exceeding 30°C for the last 5 climate normal periods (30 years) in London. (Source data from ECCC).

for London. These show a decrease in HDD and a smaller increase in CDD (note the HDD are divided by 10). These changes reflect the expected reduction in demand for winter-season heating and increase in summer cooling demand associated with large-scale climate warming.

Inspection of annual changes of HDD and CDD (Fig. 11) shows the expected variability associated with interannual and longer periods of climate variations; the low values associated with the warmth of the winters in 2023 and 2024 are apparent at the end of the record.

Regarding precipitation in the London area, the greatest departures from normal were in July (just over 200% above normal) and in December (just under 200% of normal, mostly snow). These were mainly due to a small number of heavy precipitation events.

There were no Air Quality Bulletins issued for London in the summer of 2024. Fig. 12 shows the daily maximum PM2.5 counts for London for both 2023 and 2024. PM2.5 is the fine particulate matter with a diameter of 2.5 micrometers or less. It is a mix of solid particles and liquid droplets and includes aerosols, smoke, fumes, dust, ash and pollen (Ministry of the Environment, Conservation and Parks 2022). PM2.5 can serve as an indicator for the presence of wildfire smoke. The high particulate matter counts arising from imported wildfire smoke that affected London in 2023 were absent in 2024 (Fig. 12). Significant amounts of PM2.5 can reduce the amount of incoming sunshine and limit daily maximum temperatures. They also have significant health impacts related to decreased lung function and aggravation of lung and heart conditions.

Snow and freezing precipitation

February 15: Heavy snowfall

A narrow band of heavy snow had a brief but significant impact on travel in the region. The band moved eastward across southern Ontario from and resulted in significant road closures including along Highway 402 near London, Highway 401 near Ingersoll, Highway 6 in Hamilton. Numerous collisions were reported in Oxford County, Brant, Norfolk County, and Hamilton.

March 20: Snow squalls

Late-season snow squalls off Lake Huron and Georgian Bay affected areas including London. Icy road conditions resulted in dozens of collisions throughout southern and central Ontario. Areas near Lake Huron received the most snowfall, with the highest reported accumulation of 30 cm reported near Listowel.

December 2-5: Snow squalls

A massive snow squall event took place across the Great Lakes region with some areas receiving more than 150 cm. The London climate station recorded 41.8 mm of precipitation on Dec. 2 and 48 cm of snow on the ground was reported on Dec. 3. Another round of lake-effect snow developed on December 5 resulting in pre-emptive school closures.

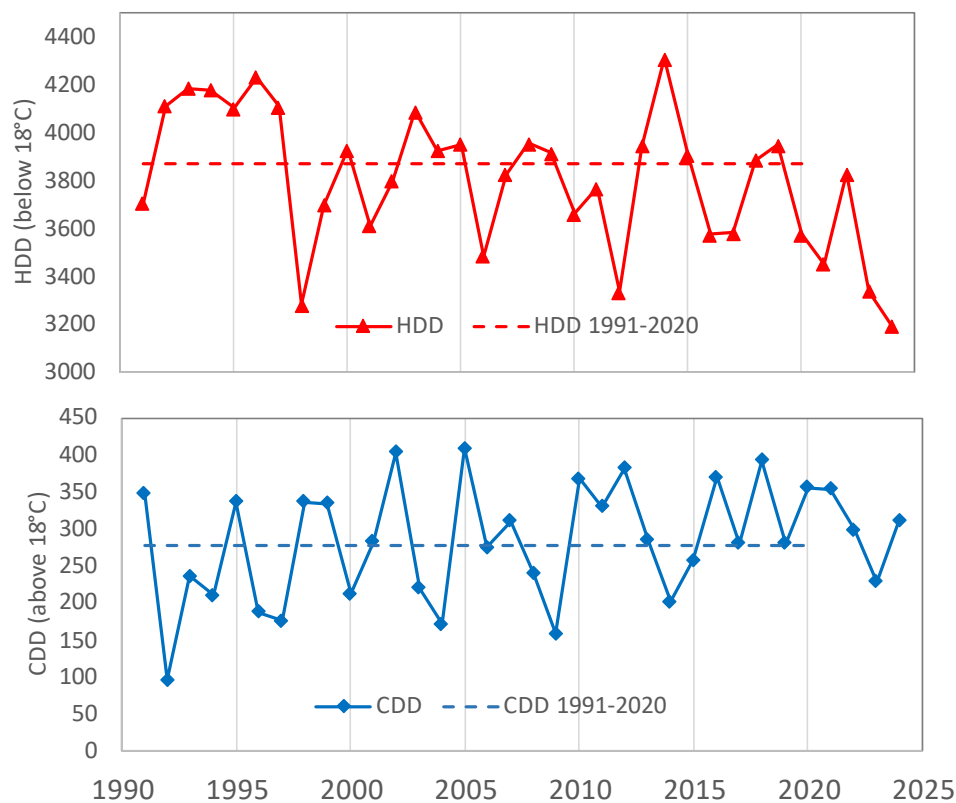


Figure 11. Annual (symbols and lines) HDD (top) and CDD (bottom) since the start of the last climate normal period (1991) with the 30-year climate normal HDD and CDD indicate by a dashed line.

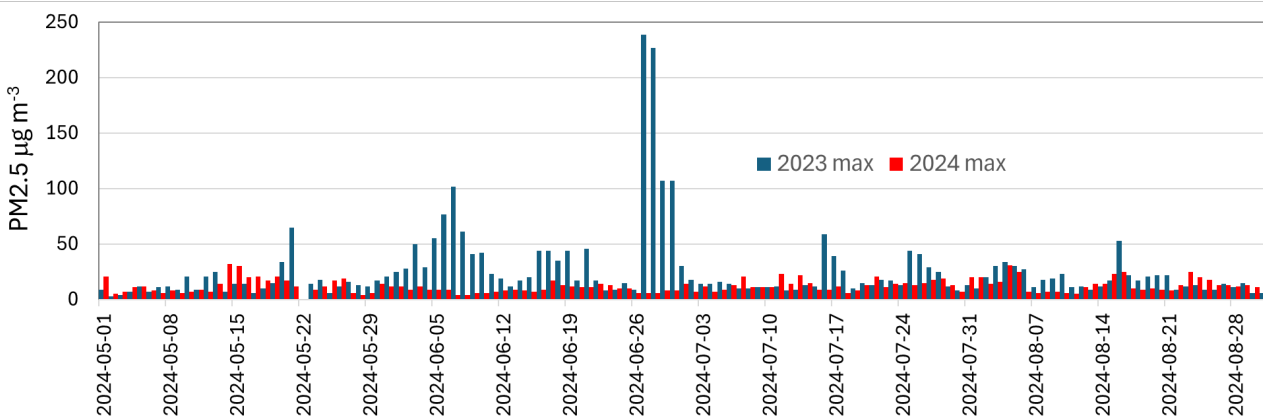


Figure 12. Daily maximum particulate matter (PM_{2.5}) concentrations for London: May 1 – Aug 31, 2023 (blue) and 2024 (red).

Heavy rain and hail events

February 27: Winter severe thunderstorms

An intense low-pressure system brought snow and blowing snow to northwestern Ontario but record-breaking high temperatures to southern Ontario. Severe thunderstorms developed in this warm, moist air mass resulting in 5000+ Hydro One customers without power in southwestern Ontario due to lightning striking trees and power lines. In London, lightning struck several houses causing minor damage. Toonie-sized hail was reported in St. Jacobs, quarter-sized hail in Erin and nickel-sized hail in London.

July 15-16: Flash flooding

Intense thunderstorms occurred over two days from London area to the GTA. On the 15th, 50-60 mm of rain over a few hours caused basement and road flooding, the closure of Highway 402 west of Strathroy, and train tracks to washout at Kitchener. At the London climate station, 59.3 mm was recorded for July 15 and 44.7 mm was recorded for July 16. The Insurance Bureau of Canada estimates the total insured losses from the storm across the region to be close to \$1B.

July 20: Damaging hail

A severe thunderstorm that began southwest of London and tracked north-northeast produced 20-40 mm hail as it intensified over the western portions of the city. There was hail damage to vehicles, gardens, backyard canopies and tree foliage, mainly in northwest London.

Damaging wind and tornadoes

June 19: Downburst-driven hail damage

There was damage caused by wind-driven hail in the Rannoch area between London and Mitchell. Up to nickel-size hailstones were driven by downburst winds to 90 km/h. There were also reports of local rain accumulations to approx. 70 mm.

August 17: Ayr tornado

A late morning tornado that hit the Town of Ayr snapped and uprooted many trees, tore the roof off the warehouse at a hardware store, and flipped empty rail cars. The damage was rated by the Northern Tornadoes Project to be EF2, with winds to 190 km/h. The damage path was found to be more than 7 km long and up to 400 m wide. There were no injuries.

References

Cannon, A. J., D. Jeong, and K. Yau 2024: Updated Observations Provide Stronger Evidence for Increases in Subhourly to Hourly Extreme Rainfall in Canada. *J. Climate*, **37**, 3393–3411, <https://doi.org/10.1175/JCLI-D-23-0501.1>.

Copernicus Climate Change Service 2025. Global Climate Highlights 2024. Available from: <https://climate.copernicus.eu/sites/default/files/custom-uploads/GCH-2024/GCH2024-PDF-1.pdf>

Environment and Climate Change Canada 2025. Climate Trends and Variations Bulletin – Annual 2024. <https://www.canada.ca/en/environment-climate-change/services/climate-change/science-research-data/climate-trends-variability/trends-variations/annual-2024-bulletin.html>

Hausfather, Z. 2025a. State of the Climate: 2024 sets a new record as the first year above 1.5°C. Carbon Brief. Available from <https://www.carbonbrief.org/state-of-the-climate-2024-sets-a-new-record-as-the-first-year-above-1-5c/>

Hausfather, Z. 2025a. State of the Climate: 2025 close behind 2024 as the hottest start to a year. <https://www.carbonbrief.org/state-of-the-climate-2025-close-behind-2024-as-the-hottest-start-to-a-year/>

Northern Tornadoes Project 2025. NTP open data and dashboard available via <https://uwo.ca/ntp>

Ontario Ministry of the Environment, Conservation and Parks 2024. Air Quality in Ontario 2022 Report. Published, Nov 8, 2024. <https://www.ontario.ca/document/air-quality-ontario-2022-report>

World Meteorological Organization 2025. State of the Global Climate 2024. Available from <https://library.wmo.int/records/item/69455-state-of-the-global-climate-2024>